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ANALYSIS OF ENSILED FISH

Bergen, September 1984

ANALYSIS OF ENSILED FISH

In silage production, it is useful to determine the composition of the silage with regard to fish species and quantities. This is a difficult task, and therefore, a preliminary survey of the possibilities was carried out. Solid components such as bones and otoliths were studied, and proteins and fats were analyzed. The results of the fatty acid analyses are presented in this report.

Sample materials and analyses

Six-kg samples of ungutted small cod, small pollack, and herring were ground, each species separately. Mixtures consisting of two or three species were prepared and stored at about 10°C for 42 days. Samples were taken 13 times during the storage period. All samples were preserved with 2.2 % formic acid. The following samples were stored in plastic buckets :

2 kg each of cod, pollack and herring, cod/pollack, cod/herring, and pollack/herring. Also, a 3-kg sample of cod/pollack/herring was stored.

Samples of ensiled fish were prepared and subjected to gas chromatographic analysis by standard procedures of the Laboratory. Fatty acid data were analyzed statistically by means of cluster analysis methods previously developed by the Laboratory.

Results and discussion

The results of the fatty acid analyses are shown in Tables 1 - 7. Figures 1 - 15 show the dendrograms prepared on the basis of these tables. As it must be possible to use the fatty acid structure for classification of fish species in a mixture, the structure must be stable or it must change systematically depending on storage time and storage conditions. Fig. 1 indicates that 13 samples of pollack stored for up to 42 days at about 10°C constitute a homogeneous group. Therefore, the fatty acid structure of pollack is stable and unaffected by storing.

Cluster analysis of cod data (Fig. 2) shows that two cod samples are different from the rest which constitute a highly homogeneous group, similarly with pollack. Therefore, it can be concluded, with some reservation, that cod has a stable fatty acid structure as well.

On the other hand, Fig. 3 shows that herring has a fatty acid structure that varies unsystematically with the storage time. Thus, fatty acid structure is not suitable for describing stored herring. It is particularly the acids with a chain length of 20 or more that vary.

Therefore, it can be expected that when herring is mixed with cod or pollack, the structure of the mixture varies with storage time unsystematically. A mixture of cod and pollack is a homogeneous group, and this confirms the conclusion that both cod and pollack have stable fatty acid structures.

Fig. 4 shows the classification of 39 cod, pollack, and herring samples stored separately by species. Cod and pollack are easily distinguishable by their fatty acid structures, while herring can be classified only as "not cod"/"not pollack". All herring samples are distinctly different from cod and pollack, but they constitute a non-homogeneous group, as pointed out above. The natural variation in the fatty acid structure within each species must be studied separately, which means that it will be more difficult to distinguish between species.

Fig. 5 shows a cod-and-pollack mixture separately compared with cod, pollack, and herring. The cod/pollack mixture shows a great affinity to either cod or pollack, and there are no examples of relatedness to herring.

Cluster analyses indicate that mixtures of herring with either cod or pollack are closely related to herring. The classification is based on the fat quantity of the mixture. Thus, fatty fish will dominate and can be verified, while lean fish can not be verified.

Herring and pollack can be verified in a mixture consisting of herring, cod, and pollack, while cod can not be detected.

The introductory trials show, therefore, that cod and pollack have fatty acid structures typical of the species and unaffected by storage. The natural variation within each species has to be studied so that it can be determined how accurately it will be possible to quantitatively distinguish between different species in a mixture. In practice, it can be expected that a mixture contains more than two species, and a quantitative determination requires multivariate data analysis. Of particular interest is PLS analysis.

When herring is added to a mixture, the species can not be distinguished by means of fatty acid analyses. It must be found out whether this applies to other fatty fish species such as mackerel and capelin as well. Also, it is important to compare the results of the fatty acid analyses with those of protein analyses.